Team Meeting #1 Minutes

June 21, 2016

Agenda

1. Meet with Scott at 12:15 P.M in order to ask questions about the system
2. Regroup after the meeting to document answers to questions that we had about the system
3. Adjourn Meeting

Notes during Meeting

Questions created by the group members:

1. Can we get a detailed description about the budget; as to where money can and should be spent? In addition to how large of a budget we will have.

2. How does the chiller system work?

3. How can we gain access to the building? Do you always need to be with us when we are looking at the components?

4. How long will the data acquisition (dead period) take?

5. How does the VFD work and contribute the system?

6. Is there anymore updated schematics of with more detailed descriptions of locations of the sensors?

7. What is our end goal of the project? Do we wish to increase the efficiency of the plant or simply increase the math model?

8. How exactly will the absorber work/influence the cycle?

9. What independent intensive properties are known at the critical points already?

10. What type of material is used for the piping of the system?

11. Where can we draw system boundaries in order to simply our solution?

Notes from Meeting

- There is a diagram system within EES but be sure to not draw components into program as it then has a tendency to crash.
- If we do put manuals within our binder we do not need to print all of them out according to Lake
- For next meeting plan to create a general system diagram that we will be able to write on to be able to more easily be able to see what information will be needed.

Team Meeting #2 Minutes

June 22, 2016

Agenda

1. Discussed our next step after touring the chiller plant
2. Create a simple sketch of the chiller loops
3. Adjourn Meeting

Notes from Meeting

- We discussed what data we will need to collect from each chiller/loop
- We discussed whether or not data needed to be gathered from each state of each individual internal component in order to create the math model
- We also need to determine what independent intensive properties can be determined of the steam with sensors at hand or will more need to be purchased
- Scott joined us an clarified that each chiller can be considered one component, we don't need to account for all the internal parts in order to calculate internal energy
- We will need to collect pressure and temperature measurements at the entrance and exist of each chiller
- The cooling tower takes out reject heat
- Eventually with this math model we could potentially answer the question: what is our max limitation in this system?
- We now have a better idea of what each loop consists of and what needs to be done next
- Next step: collect face plate data from each chiller and find out what sensors we already have and what sensors we need to add.

Team Meeting 3/Client Meeting 1 (6/23/16)

Overview: Our client meeting started by each of us asking Scott various questions about the North Campus Chiller Plant (NCCP). He gave us lots of good insight as to what our expectations are for this project. He went over what will be expected for purchasing and making use of our budget, what the desired outcome is for the chiller plant, and what Scott would like to see done overall.

Questions Asked:

1.) **How will the budget be handled?**

a.) We need to go to Scott for every item that we will be purchasing, and get his approval.

b.) There isn't an exact budget and we can buy whatever is needed for the project within reason, and is paid for through the department.

2.) **How does the chiller system work?**

a.) Using refrigerant R-134A. The chiller consists of a compressor, condenser, evaporator, and expansion valve. It utilizes low to high pressure.

3.) **How will we gain access to the Chiller plant?**

a.) The plant is open 24/7.

b.) There are a set of double doors on the East side of the building that we can gain access to.

c.) We can be at the steam plant as needed even if Scott isn't there, we just need to email Scott ahead of time and tell the workers that we are there for our project.

4.) **How long will the data acquisition period be?**

a.) Data needed to validate our math model will take a couple months to obtain.

5.) **How does the VFD work and how does it contribute to the system?**

a.) The speed of the compressor motor varies which the amount of chilling.

b.) The speed is manually changed, but it will be automated this summer.

6.) **Is there any updated schematics with more detailed descriptions of the locations of the sensors?**

a.) Scott sent us the line drawings to the group email.

7.) **What is the end goal for the project? Do we want to increase efficiency of the plant or just make an effective math model?**

a.) Our main concern is to create the math model in EES and validate it. Hopefully the work that is completed can be used by future capstone students.

8.) **How will the absorber work and influence the system?**

a.) It is similar to the chiller but doesn't have an absorber.

9.) **What independent intensive properties are known at the critical points already?**

a.) We will do a run through in the plant to find out all the data at the critical points and find where the existing sensors are.

10.) **What type of material is used for the piping?**

a.) Schedule 40 steel pipe with OD of 10 inches.

11.) **Where can we draw system boundaries in order to simplify our solution?**

a.) We will not take into consideration the rooftop components of the system.

b.) The chiller plant will be counted as one loop and the campus tunnels as another.

Revised Problem Statement: Create a mathematical model for the North Campus Chiller Plant by observing the individual loops of the chiller system with respect to the system as one loop itself. Determine where the additional pressure flow and temperature sensors are needed for the system in order to validate our math model, purchase, and install them. Lastly, find ways to make the chiller system more efficient by locating weaknesses in the system.

Initial set of Target Specs:

1.) Manufacturer's information of the components such as: pumps and chillers.

2.) Length of the piping in the system.

3.) Number of T's Y's and Elbows in the system.

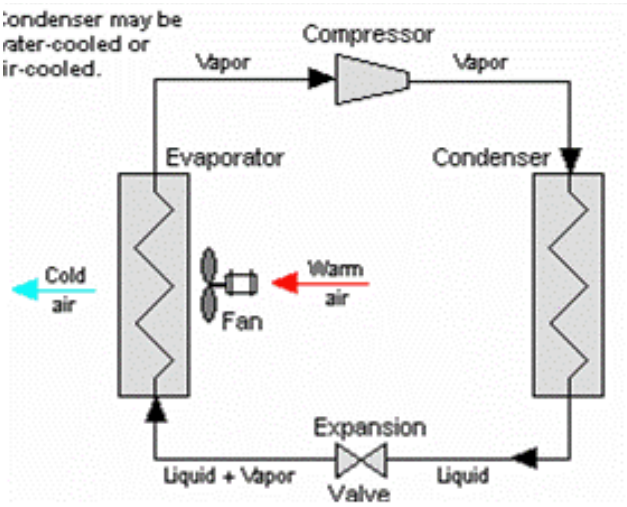
4.) Independent intensive properties before and after components.

5.) Drops in elevation across the piping system.

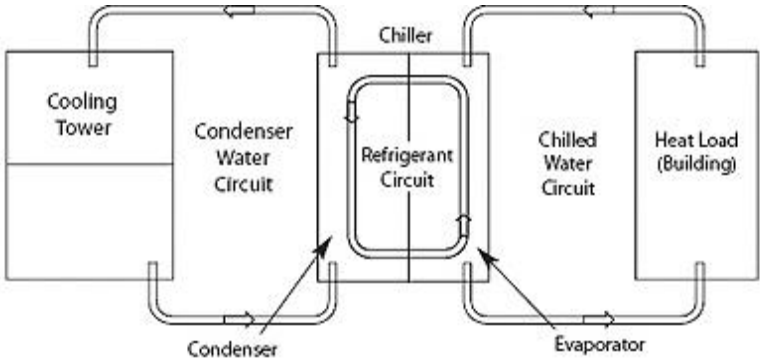
6.) Change in pressure across components.

Relevant System Diagrams:

Isolated chiller cycle:



Combined chiller cycle:



Team Meeting #4 Minutes

June 26, 2016

Agenda

1. Measure pipes in order to calculate head losses for cooling systems 2 and 4
2. Adjourn Meeting

Notes from Meeting

- We attempted to take pipe length measurements but realized it would be very difficult
- Instead we familiarized ourselves with the piping and figured out how the water travels in each system in each pipe
- We decided to make a sketch that accurately depicts what is going on before taking actual pipe length measurements

Team Meeting #5 Minutes

June 28, 2016

Agenda

1. Meet with client and discuss parts we need to order
2. Discuss what we need to work on next
3. Adjourn Meeting

Notes from Meeting

- We need to have electric sensors everywhere so data will be automatically collected
- P&ID is an electric drawing that keeps track of where sensors are. We should make one for NCCP using Viseo.
- Learn more about the absorption part of the cycle now that we understand the chilling components more.
- Cliff drew each part of the system separately so we could draw where we need sensors and which ones we need. We will do a walkthrough to double check which sensors are already in the desired locations and which ones need to be ordered.
- We will need 3 types of sensors so we split up ones to research: Alejandro will look into flow sensors, Shelby will look into temperature sensors, Rachal will look into pressure sensors.

Next Steps:

- Get parts ordered
- Work on wikipage
- Work on rough draft of math model for each loop

Team Meeting #6&7 Minutes

June 29-30, 2016

Agenda

1. Go through the plant to see what sensors we already have
2. Adjourn Meeting

Notes from Meeting

- We went through each chiller system and determined the parts we already have
- After comparing what we have to what we want we were able to verify which parts need to be ordered

Next Steps:

- Do some research on temperature and pressure sensors in order to determine which ones we want to get ordered

Team Meeting #8 and Client Meeting

July 6, 2016

Agenda

1. Meet with Scott at 12:15 P.M in order to discuss researched sensors
2. Further discuss obtaining Visio
3. Adjourn Meeting

Notes from Meeting

- Possible enthalpy sensors found by Shelby for only 50 dollars
    - Uses Honeywell; Scott will look into it and get back to us
- McMaster-Carr pressure sensors should also be looked into; be sure to include a negative side to not short out
    - Positive maximum should be up to 300 psi
    - 0.25 inch NPT
    - 0.25 % accuracy may be too accurate
- Scott will send out old EES files for example of Absorbers and Cooling Towers
- Someone will need to be read to give a speech on state of the project for the upcoming general session
- Schedule a design review to finalize instrumentation and what we need the most feedback on
- Marc Compton may be able to help with obtaining Visio
- Scott has a list of his choice of sensors, after final research done by team tonight final decisions on instrumentation will be made tomorrow.

Team Meeting #9

July 7, 2016

Agenda

1. Meet with Scott at 12:15 P.M for final discussion on instrumentation
2. Adjourn Meeting

Notes from Meeting

- McMaster-Carr pressure sensors Alex found match up to the ones Scott had in mind
    - 13 pressure sensors require the range 0-300 psi
    - 5 pressure sensors require the range -15-30 psi
    - 2? More pressure sensors require the range -15-30 psi
    - 1? Pressure sensor require a range of 0-150 psi (for steam)
- F-3500 flow sensor will ordered from Onicon

Team Meeting #10 Minutes

July 12, 2016

Agenda

1. Team meeting with Beyerlein, Scott, and Andrew
2. Adjourn Meeting

Notes from Meeting

- Pressure sensors are ordered, Scott is still deciding on enthalpy sensors
- Pressure sensors should be here in about a week but ATS isn't ready yet. The sensors should be getting connected to ATS the week of July 28th
- Find out about getting Visio
- Start simple with the math model then add detail. Make a line drawing and mark where our sensors are and what needs to be calculated at each point
- Get Penoncello's book and the cooling tower book from Scott
- The week of July 26th would be a good time for design review

Team Meeting #11 Minutes

July 13, 2016

Agenda

1. Alejandro and Rachal work on math model
2. Adjourn Meeting

Notes from Meeting

- For pumps, we need to get the specs in order to get the efficiencies
- Components to take into account for the cooling tower loop:
    - Fluid: in and out of the tower as well as the water in the bottom
    - Air coming into the fans and air leaving the top of the towers
    - Pump, work of the pump
    - Q_dot condenser

Team Meeting #12 Minutes

July 18, 2016

Agenda

1. Alejandro and Rachal work on math model
2. Meeting with Scott and Beyerlein
3. Adjourn Meeting

Notes from Meeting

- Throughout this week Rachal and Alejandro will add the rest of the chillers into the EES codes
- We are coming up with a labeling pattern for each chiller that will be consistent
- We need to look at pump curves for primary and secondary pumps
- Sensors will hopefully be here last week of July so data will be able to be collected by the time fall semester begins
- Let's plan a meeting to have Andrew show us how ATS data comes in
- Have Visio P&ID to put in EES
- Make design review as a group with Scott
- Ideas of things to include in design review:
    - Talk about parts ordered
    - What do we want to be able to answer at the end of the project
    - Show preliminary code
    - Visio Model
    - Explain how we are waiting for parts/ATS to connect the sensors to the system and how that will electronically log all the data

Team Meeting #13 Minutes

July 19, 2016

Agenda

1. Regroup
2. Adjourn Meeting

Notes from Meeting

- We met up as a group because we have been working on things in groups of 2 in order to catch everyone up on our progress.
- We set a meeting time up with Scott for tomorrow in order to ask him what he wants in our design review and to clarify the internal parts of the chillers

Team Meeting #14 Minutes

July 20, 2016

Agenda

1. Meet with Scott in his office
2. Adjourn Meeting

Notes from Meeting

- 4 enthalpy sensors were ordered for the cooling towers
- Beyerlein suggests looking internal of the chillers at some point add them into our black box code
- How many states are inside each chiller?
    - Chiller 4: 4 components
    - Each cooling tower: 6 components
- Scott is available every day the next 2 weeks at 11:30-12:30 to attend design review
- Things Scott wants included in the design review:
    - Well defined scope
    - Specs of equipment
    - Identified locations of where data needs to be collected
    - Plans of implementation
    - Next steps to get us to the end of the project

Team Meeting #15 Minutes

July 21, 2016

Agenda

1. Meet as a team to discuss our plans for design review
2. Adjourn Meeting

Notes from Meeting

- We are planning to do our Design Review on Thursday July 28th
- We need to inform Beyerlein and Scott of this date
- Shelby will work on the power point over the weekend and we will all work on it together next week
- We need to take a nice team pic
- We need to talk to Andrew next week about becoming familiar with the ATS data acquisition system
- Monday Rachal and Alejandro will begin to add diagram of the system into EES and work on figuring out a numbering scheme for the system

Team Meeting #16 Minutes

July 25, 2016

Agenda

1. Short meeting as a team to discuss our plans for design review
2. Adjourn Meeting

Notes from Meeting

- Finalized time for design review July 28th 11:30 am in the EP conference room
- Team pic Wednesday
- Rachal and Alejandro will be working on a new numbering system and EES diagram
- Questions about design review:
    - How do we dress?
    - Do we all talk?
    - Are any other design reviews scheduled yet?

Team Meeting #17 Minutes

July 26, 2016

Agenda

1. Short meeting as a team to discuss our plans for design review
2. Adjourn Meeting

Notes from Meeting

- We considered a new numbering system, but decided it was too complicated and wouldn't make anything necessarily better in the code. We decided to stick to color coordinating our code instead of switching systems
- Design review suggestions from Beyerlein
    - Add pics
    - What we used for instruments
    - Rearrange goals
    - Instrumentations
    - Math model development
    - Explain P&ID with instrumentation
    - Go through how math model works and our plan with it
    - Update timeline and goals

Team Meeting #18 Minutes

July 27, 2016

Agenda

1. Meeting as a team to discuss our plans for design review
2. Adjourn Meeting

Notes from Meeting

- We all combined our work to include in the powerpoint including EES Code, EES diagram of the system, and P&ID
- We also made the changes suggested by Beyerlein to our presentation
- We will take our team photo tomorrow following our presentation
- Other than the design review we are at a stand still with our project since we are waiting on parts to arrive and be installed and then next week is snapshot day and the end of summer session